CLAIMS

I claim:

1. A method used in model predictive control applications for removing the effect of unmeasured disturbances from the dynamics of a controller model of a process having a plurality of independently controllable, manipulated variables and at least one controlled variable dependent upon said independently controllable, manipulated variables comprising the steps of:

> gathering data about said process by separately introducing a test disturbance in each of said manipulated variables and measuring the effect of the disturbances on said controlled variable;
>
> using said effects of the disturbances on said controlled variable to generate a first linearized dynamic model relating said at least one controlled variable to said independently controllable, manipulated variables;
>
> interchanging selected valve position controlled variables with their corresponding selected independently controllable, manipulated PID controller set point variables in said first linearized dynamic model using matrix row elimination mathematics to generate a second linearized dynamic model that has a new set of independently controllable, manipulated variables, said second linearized dynamic model having the dynamics of said selected independently controllable, manipulated PID controller set point variables removed from said second dynamic model.

2. The method of claim 1 wherein said first linearized dynamic model is a step response model.

3. The method of claim 1 wherein said first linearized dynamic model is a finite impulse model.

4. A method for controlling a process having a plurality of independently controllable, manipulated variables and at least one controlled variable dependent upon said independently controllable, manipulated variables comprising the steps of:

> gathering data about said process by separately introducing a test disturbance in each of said manipulated variables and measuring the effect of the disturbances on said controlled variable;

using said effects of the disturbances on said controlled variable to generate a first linearized dynamic model relating said at least one controlled variable to said independently controllable, manipulated variables;

interchanging selected valve position controlled variables with their corresponding selected independently controllable, manipulated PID controller set point variables in said first linearized dynamic model using matrix row elimination mathematics to generate a second linearized dynamic model that has a new set of independently controllable, manipulated variables, said second linearized dynamic model having the dynamics of said selected independently controllable, manipulated PID controller set point variables removed from said second linearized dynamic model;

measuring the present value of said variables;

calculating for discrete intervals of time from said gathered data about said process, said measured present values and pre-selected operating constraints a set of moves for present and future times for at least said manipulated variables to obtain new values for said manipulated variables and to move said at least one dependent controllable variable towards at least one of said constraints; and

changing said process by adjusting said manipulated variables for said set of moves for present and future times to cause said process to move said at least one dependent controllable variable towards at least one of said constraints.

5. The method of claim 4, wherein said process comprises at least one uncontrolled variable that is dependent on said manipulated variables and wherein said step of calculating said set of moves for present and future times further comprises calculating said set of moves such that said uncontrolled variable is limited to a predetermined constraint.

6. The method of claim 5, wherein said step of calculating said set of moves for present and future times further comprises calculating said set of moves such that at least one of said manipulated variables is limited to a predetermined constraint.

7. The method of claim 4, wherein said step of calculating said set of moves for present and future times comprises calculating said set of moves employing quadratic programming techniques.

8. The method of claim 7, wherein said step of calculating said set of moves for present and future times further comprises calculating said set of moves such that at least one of said manipulated variables is limited to a predetermined constraint.

9. The method of claim 7, wherein said process comprises at least one uncontrolled variable that is dependent on said manipulated variables and wherein said step of calculating said

set of moves for present and future times further comprises calculating said set of moves such that said uncontrolled variable is limited to a predetermined constraint.

10. The method of claim 4, wherein said step of calculating said set of moves for present and future times comprises calculating said set of moves employing linear programming techniques.

11. The method of claim 10, wherein said step of calculating said set of moves for present and future times further comprises calculating said set of moves such that at least one of said manipulated variables is limited to a predetermined constraint.

12. The method of claim 10, wherein said process comprises at least one uncontrolled variable that is dependent on said manipulated variables and wherein said step of calculating said set of moves for present and future times further comprises calculating said set of moves such that said uncontrolled variable is limited to a predetermined constraint.

13. The method of claim 4, wherein said step of calculating said set of moves further comprises calculating said set of moves such that at least one of said manipulated variables is limited to a predetermined constraint.

14. The method of claim 13, wherein said process comprises at least one uncontrolled variable that is dependent on said manipulated variables and wherein said step of calculating said set of moves for present and future times further comprises calculating said set of moves such that said uncontrolled variable is limited to a predetermined constraint.

15. A method for developing a new linearized dynamic model of a process without performing a new plant identification test when the tuning of at least one PID controller in said process is changed comprising the steps of:

> interchanging said at least one PID controller set point variable in an original linearized dynamic model with its corresponding valve position controlled variable in said original linearized dynamic model using matrix row elimination mathematics to generate a secondary linearized dynamic model that has said at least one corresponding valve position as a new independently controllable, manipulated variable

> externally emulating new desired PID tuning via mathematical emulator to emulate the effect of said at least one PID controllers new tuning with the secondary linerarized dynamic model

> testing the secondary linearized dynamic model with it's emulated PID tuning by stepping each of it's manipulated variables to obtain said new linearized dynamic model that will now contain the dynamics of said at least one PID controllers

16. A method for creating an off-line process simulator for use in process simulation and for training simulators created by removing the effect of unmeasured disturbances from the

dynamics of a controller model of a process having a plurality of independently controllable, manipulated variables and at least one controlled variable dependent upon said independently controllable, manipulated variables comprising the steps of:

gathering data about said process by separately introducing a test disturbance in each of said manipulated variables and measuring the effect of the disturbances on said controlled variable;

using said effects of the disturbances on said controlled variable to generate a first linearized dynamic model relating said at least one controlled variable to said independently controllable, manipulated variables;

interchanging each independently controllable, manipulated PID controller set point variable with its corresponding valve position controlled variable in said first linearized dynamic model using matrix row elimination mathematics to generate a second linearized dynamic model that has said corresponding valve positions as a new set of independently controllable, manipulated variables, said second linearized dynamic model having the dynamics of said selected independently controllable, manipulated PID controller set point variables removed from said second linearized dynamic model;

externally emulating desired regulatory control schemes via mathematical emulators to emulate PID controllers in either manual, cascade, or automatic modes.

17. An off-line process simulator created from an empirical dynamic model by the method of claim 16.